

A Matched Filter Analysis of SDSS DR8 Photometry in the Vicinity of the Cetus Polar Stream

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Abstract. We examine the region of sky in the vicinity of the Cetus Polar Stream and find indications of at least three narrow and metal poor streams at distances ranging from 28 to 37 kpc and extending over 60 degrees of sky. We suggest that we may have resolved the substructure in this region into a number of relatively cold streams, and that the original Cetus Polar Stream detection may have sampled two or more of these streams. Similarities in distance and orientation suggest that these streams may be dynamically related and/or share a common origin.

1. Introduction

The number of stellar debris streams that we can trace over an appreciable portion of their orbits currently stands at 14 (Grillmair 2010). Since we can measure all six phase space coordinates for the stars in these streams, they have the potential to significantly improve our understanding of the mass distribution in the Galaxy, particularly in regions where we have no comparable tracers (Law & Majewski 2010; Newberg et al. 2010; Koposov et al. 2010). The coldest streams are particularly interesting as they may provide a sensitive means of detecting dark matter subhalos (Carlberg 2009; Yoon et al. 2011). Here we examine the region around the recently detected Cetus Polar Stream (Newberg et al. 2009) in the hopes of further refining its position, orientation, and extent, and to select targets for spectroscopic follow-up.

2. Analysis

Photometric data in g , r , and i were extracted from the Sloan Digital Sky Survey (SDSS) Data Release 8. We used theoretical isochrones to construct color-magnitude filters and generate the filtered surface density map shown in Figure 1. The new streams appear as long, narrow enhancements extending across the southern SDSS footprint. Using the “T” statistic of Grillmair (2009), we find that the northern half of stream ‘a’ is detected at a signal-to-noise ratio of 7. The stream has a FWHM of 30 arcmin, or about 150 pc at a distance of 37 kpc. This is similar to the widths measured for presumed globular cluster streams (Grillmair & Dionatos 2006a,b; Grillmair 2011). On the other hand, there are indications of either a broader, 1.2 kpc wide stream characteristic of presumed dwarf galaxy streams (Grillmair 2006a, 2009) or possibly multiple stream components (Grillmair 2006b)). The stream candidates labeled ‘b’ and ‘c’ are only marginally detected. The similarities in distance and orientation suggest that these streams may share a common progenitor or infall event.

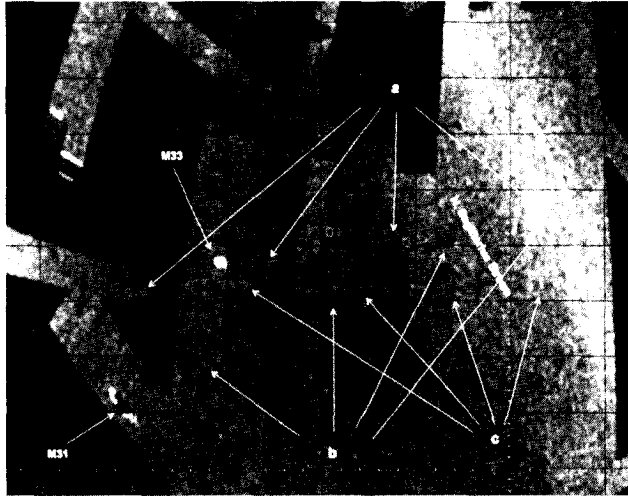


Figure 1. — A filtered surface density map of a portion of the SDSS DR8, using a matched filter based on a theoretical isochrone with $Z = 0.0001$ and an age of 12 Gyr, optimized for a distance of 36 kpc. The image has been smoothed with a Gaussian kernel with a width of 20 arcmin. The new streams are labeled 'a', 'b', and 'c'. The Cetus Polar Stream detections (Newberg et al. 2009) are shown as boxes. Coordinates are in offset RA and dec, with north to the left and east upwards.

References

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